Methods for Data-Intelligent Operation of Low Temperature DH Systems

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Outline of the presentation

- Data Intelligent Temperature Optimatizon v.2.0 (Current)
- Data Intelligent Temperature Optimatizon v.4.0 (Future)
- Usage Case of Smart-Meter-Data in Lund (Preliminary results)

Data Intelligent Temperature Optimization

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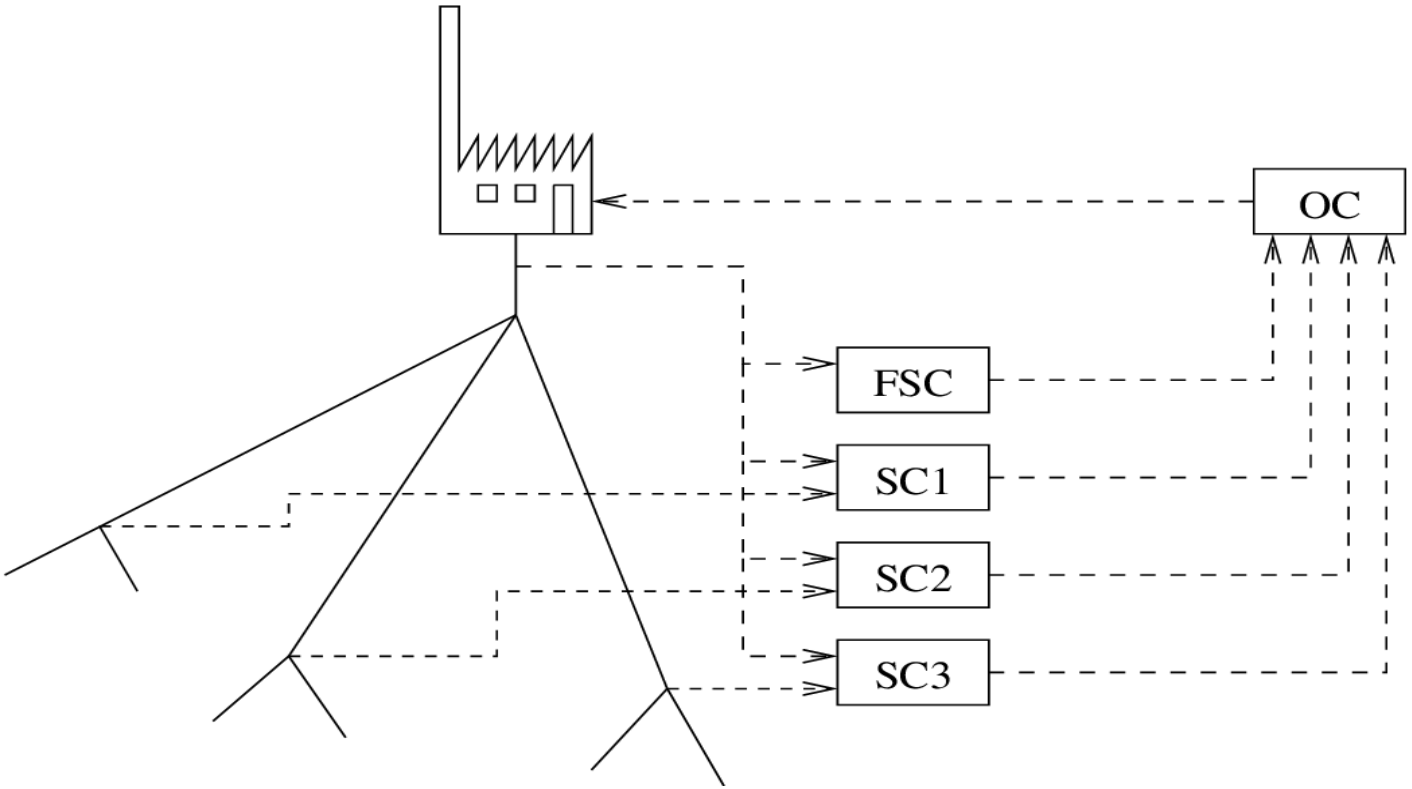
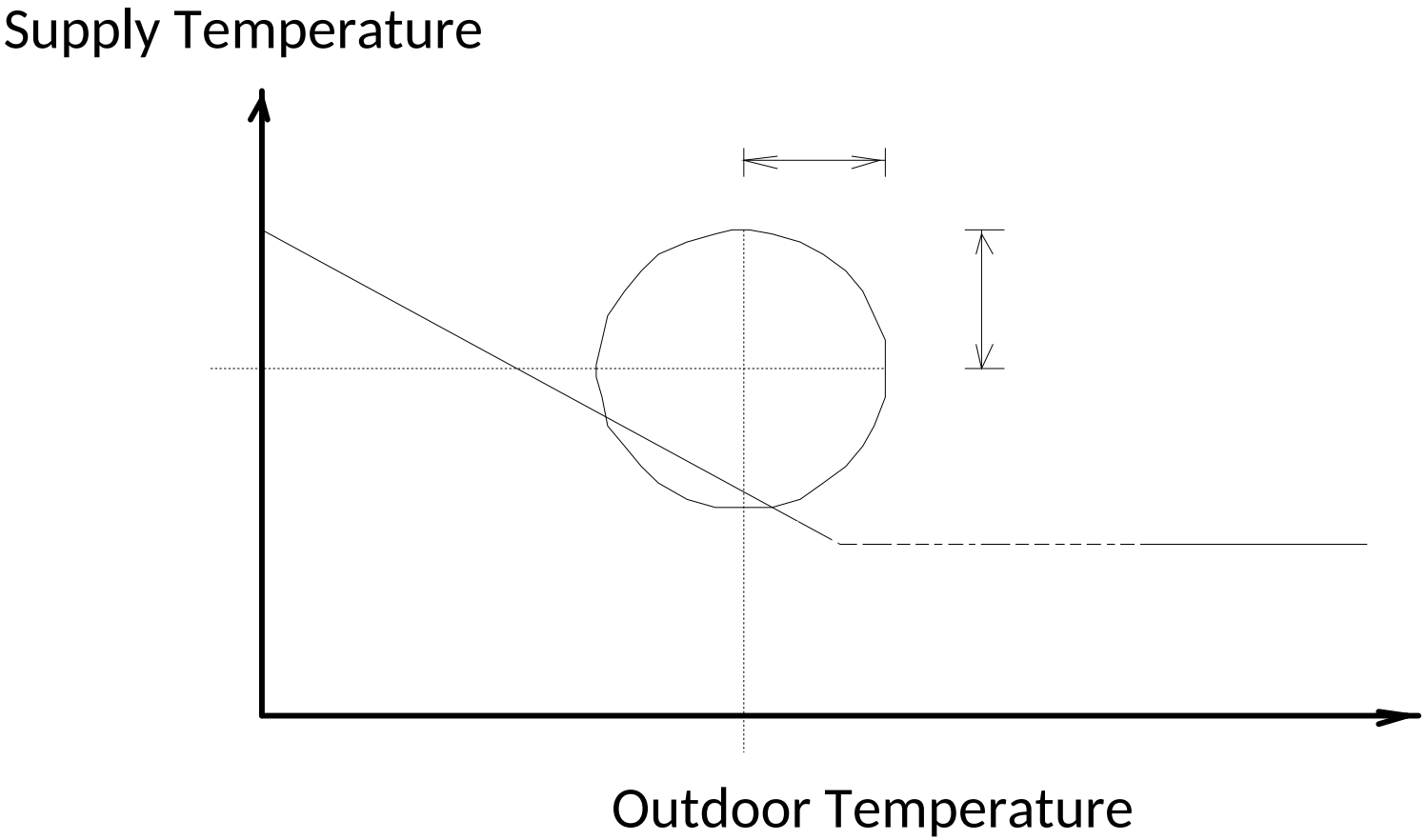
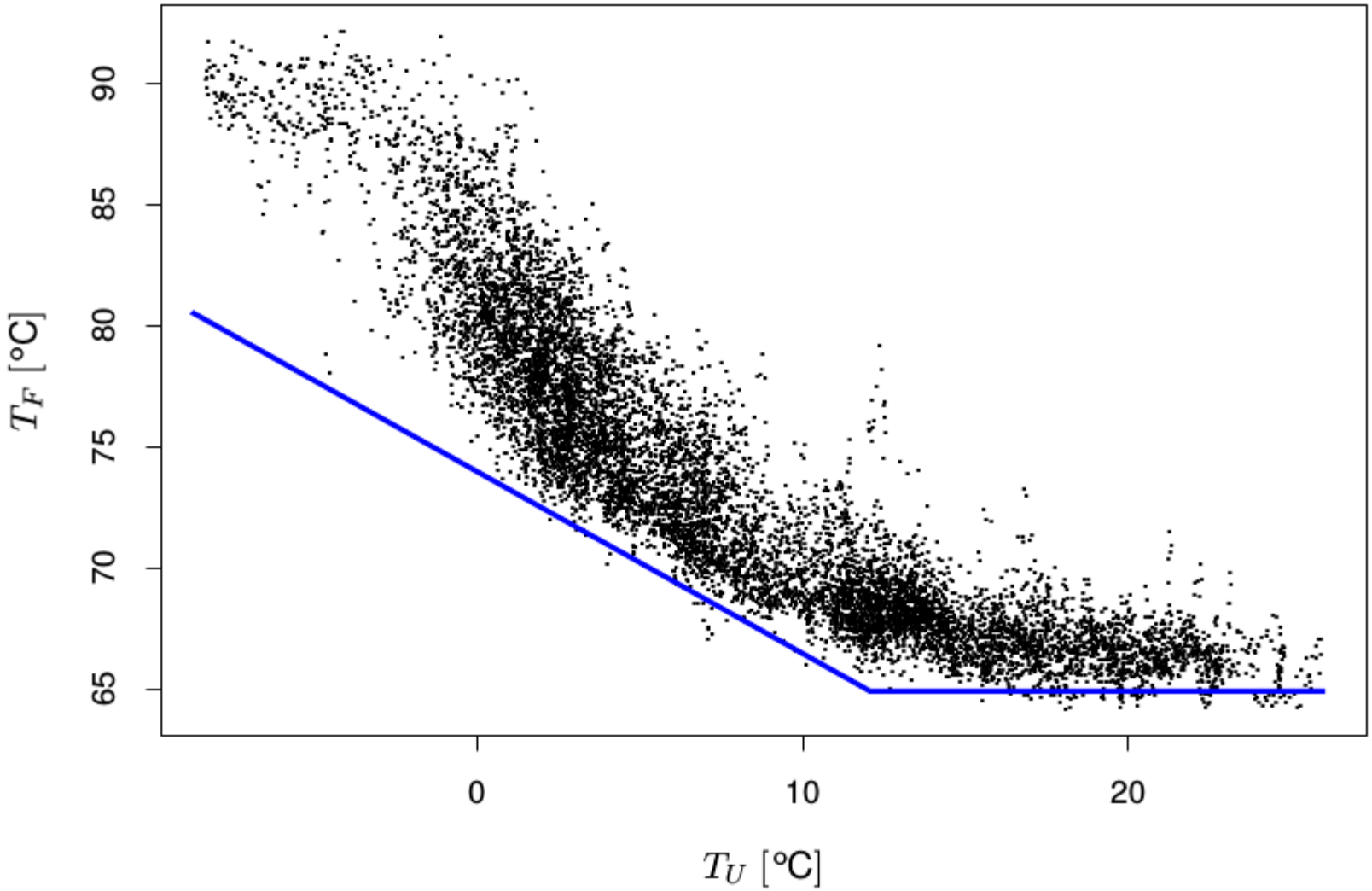
Models and Controllers (Highly simplified!)



Optimal set-point taking uncertainty into account

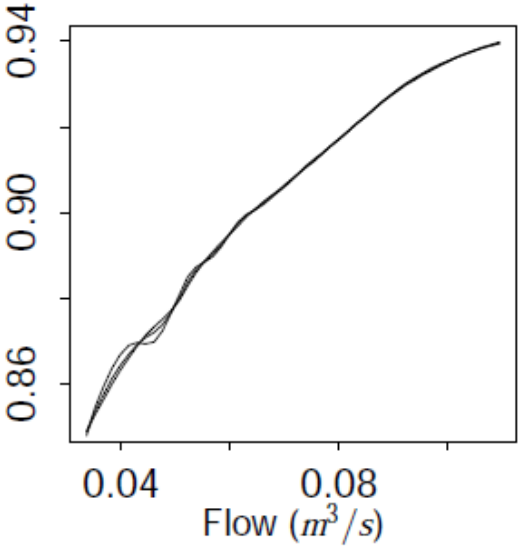



T_F [°C]
90
85
80
75
70
65
0
10
20
T_U [°C]

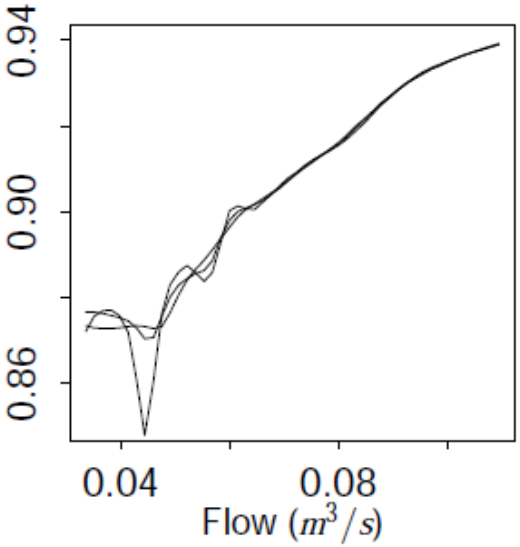
Characteristics

30%, 40%, 50%

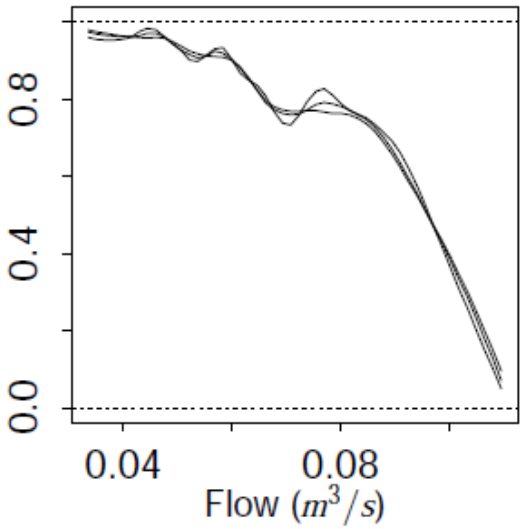
Stationary gain of FIR



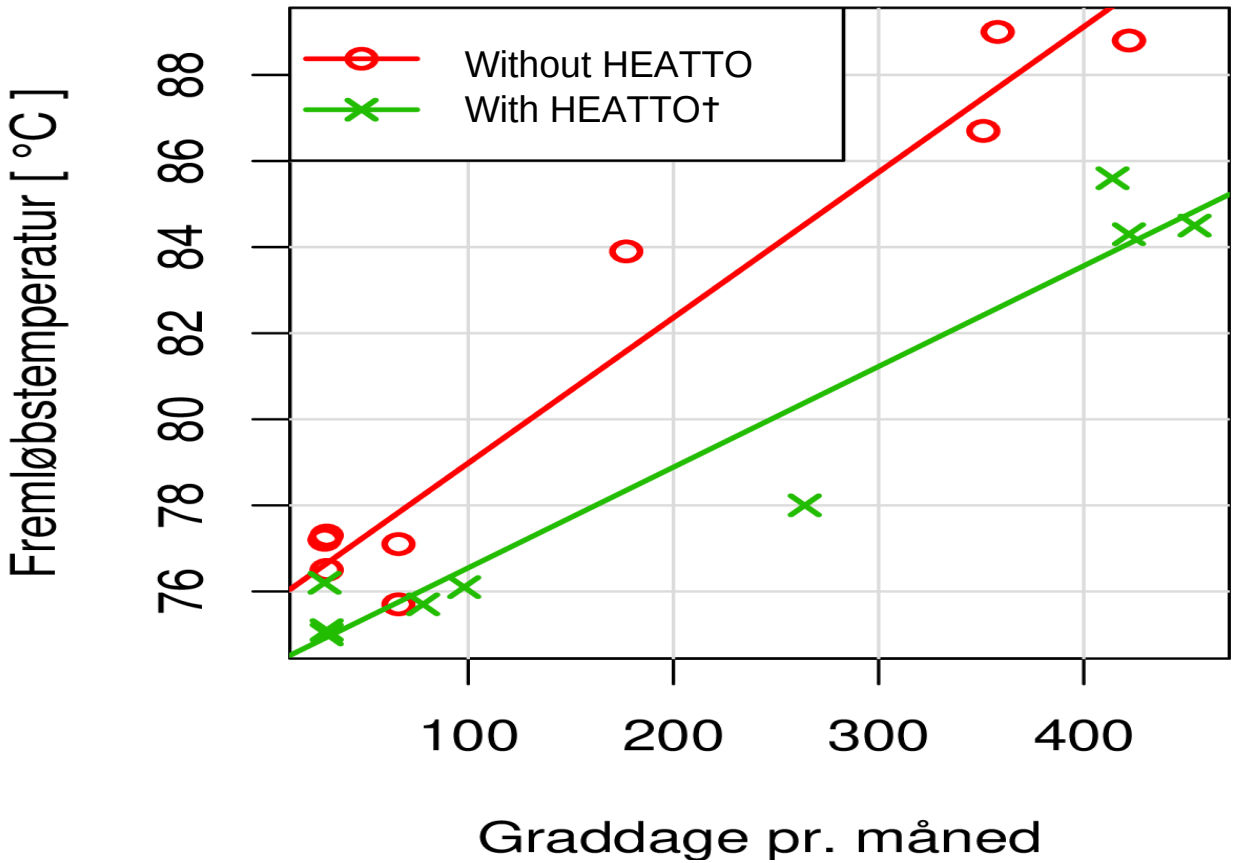
Stationary gain of ARX



Pole of ARX



Supply temperature with/without data intelligent control



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Savings
(Reduction of heat loss = 18.3 pct)

	Heat Supply		Electricity	
	GJ	1000 DKK	kWh	1000 DKK
Without HEATTO	653,000	30,750	499,000	648
With HEATTO†	615,000	28,990	648,000	842
Difference	37,400	1,760	-149,000	-194

Total savings (The 9 first months of normal year): 1,566,000kr

Savings for one normal year:

- 12/9 x 1,566,000kr = **2.1 millions**
- However, the period from Jan to Sept (75% of the year) is only ca. 65% degree days of the normal year
- 1.566.000/0.65 = **2.4 millions**

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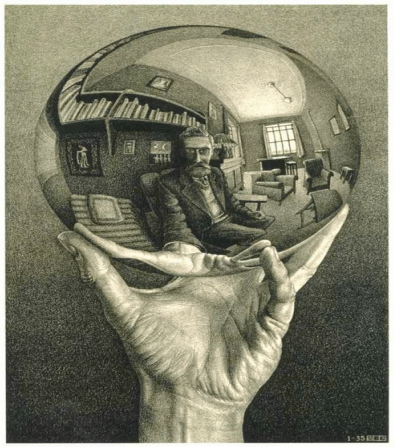
Data Intelligent Temperature Optimization for DH Systems

- Able to take advantage of **information in data**
- **Self-calibrating** models for the DH network
- **Temperature zones** are easy to establish
- Shows where to **upgrade** the DH network
- **Fast** (real time) calculations
- Use DH net for **peak shaving** and **storage**
- Able to use **online MET forecasts** etc.



Data Intelligent Temperature Optimization using Meter Data (v.4.0)

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Workshop District Heating, Zagreb. 2019

Smart Meter Data in District Heating

- Measurement feedback from end-users
  - Supply Temperature, Return Temperature and Flow measurements on e.g. 1 hour interval.
  - Data for information, monitoring and control purposes
- The EU requires at least 80% consumers will have smart meter by 2020.
- End-users can be more aware of their consumption and can control it based on their needs (time-varying prices)

Meter Data in Data Intelligent Temperature Optimization (v.4.0)

- Gives the oppurtunity take the advantage of meter reading using big data analytics tools.
- Having different **temperature zones** inside the network with additional pressure pumps and heat pumps.
- Use all available MET forecasts. Also, combination of local climate stations is possible.
- Creating new grey-box models based on the end-user consumption intellingence.

Multiple Temperature Zones inside a city

- Combining HEATTO† and smart-meter data to control several different temperature zones inside a city
- Removing pre-selected critical points from the network using the meter data
- Controlling areas with new sustainable buildings with lower supply temperature and large old unefficient buildings with higher temperature

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Smart Meter Data intellingence

- Eliminates or reduces the need for critical points in the DH net
- Filtering of #N smart meter readings -> available temperature
- Identify needs for upgrade of the local network
- Find users with a high flow
- Next generation of temperature zones
- Intell. Control – energy, emission, costs, peak,..
- Use user installations to store energy locally
- Time-varying prices – active use of end-users
- Establish a possibility for effect limitations

  (should be reflected in the contract)

Savings

- A new report shows there is a potential of saving about 240-790 Million DKK by reducing the temperature of about 3-10 degrees using data-driven temperature optimization*.
- Addition savings when implementing tools using the meter data. Only time will tell how much the additional savings based on the meter data
- Also, no need for critical points – Savings on maintenance.

* Potentialet ved dynamisk datadrevet temperaturregulering i fjernvarmesektoren, DANVAD Analytics & Dansk Fjernvarme, 2019-02

Usage case of Smart Meter intelligence in Lund‡.

‡ Kraftringen

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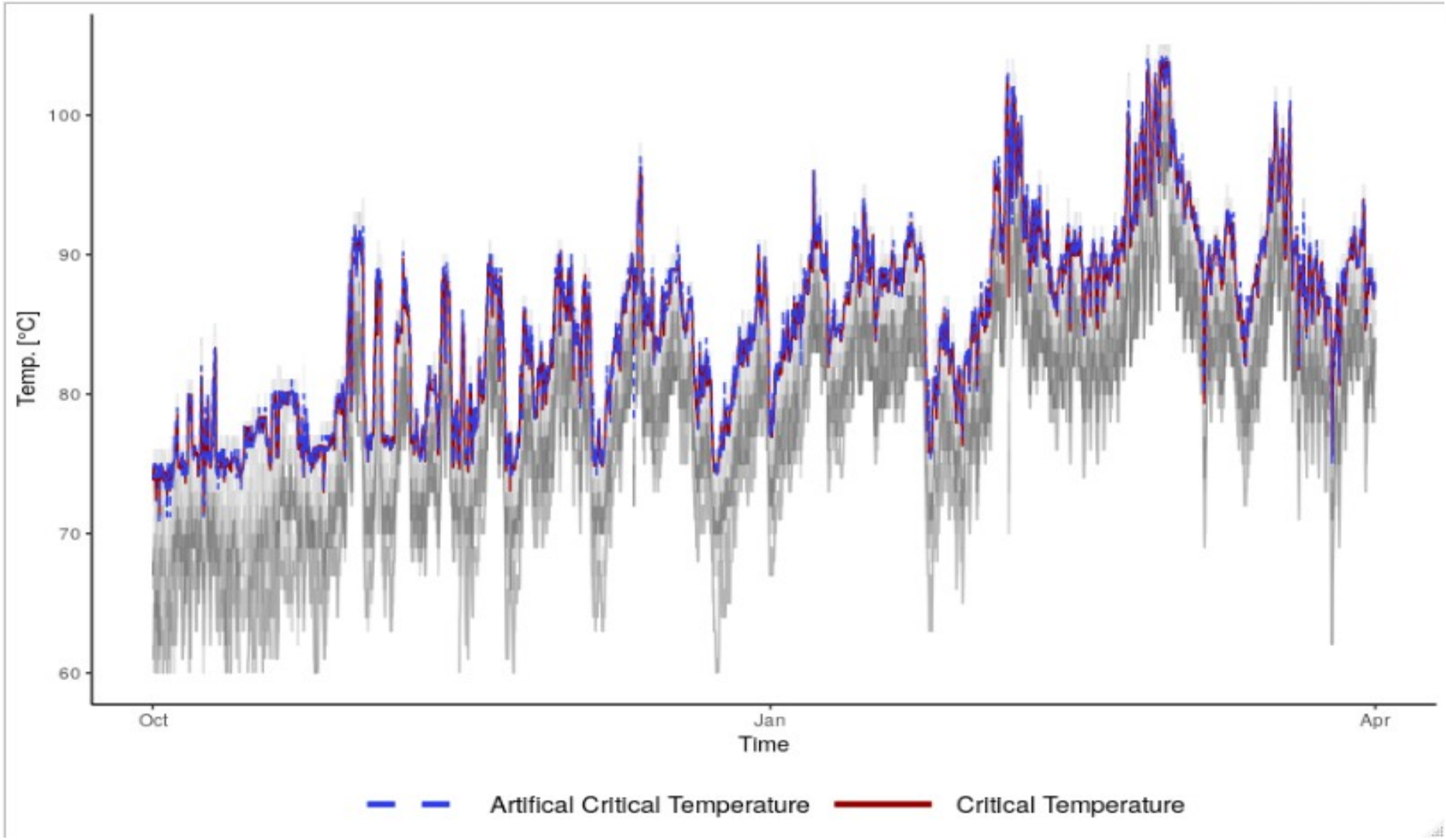
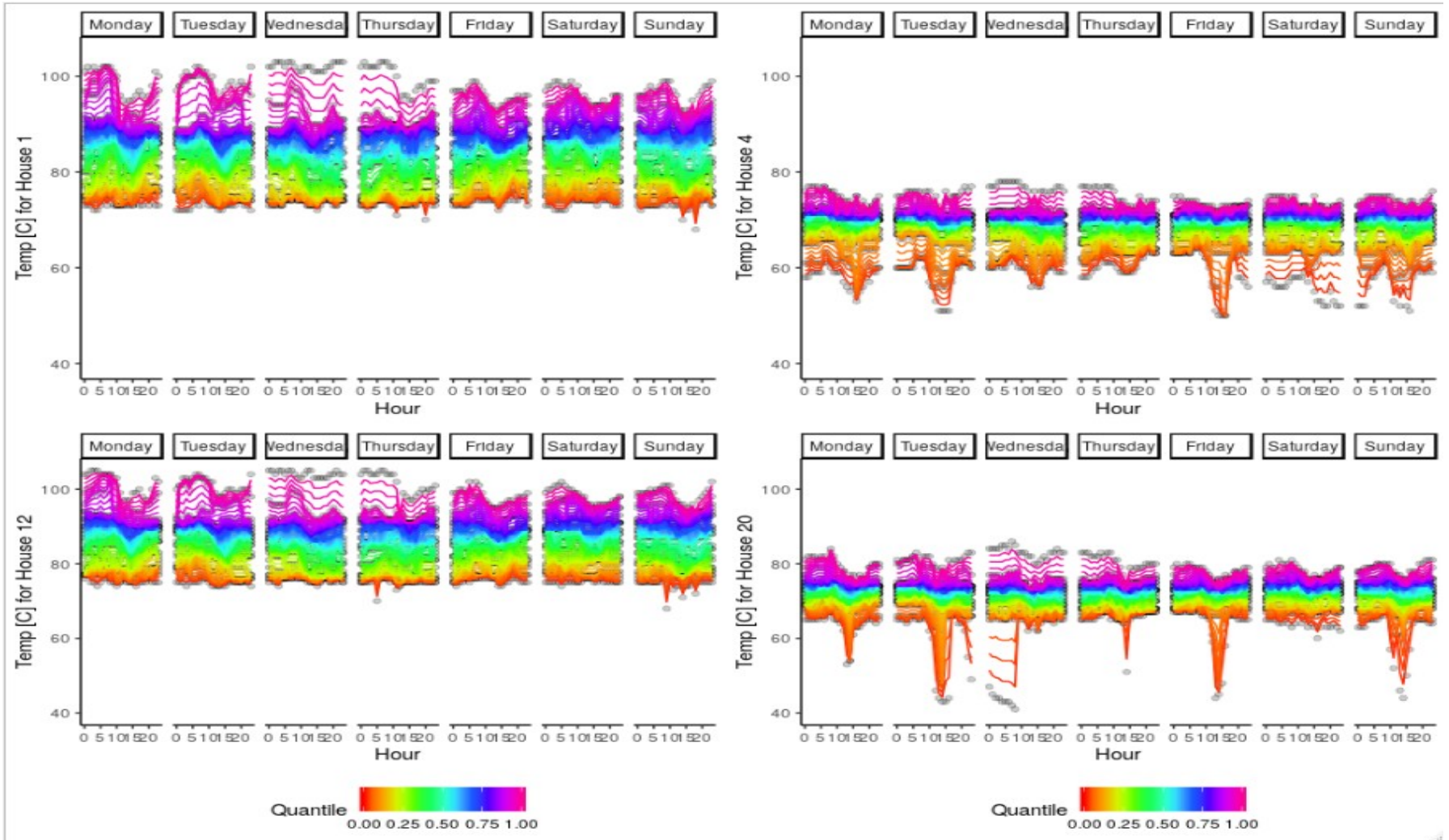
Replacing the temperature at the critical point using meter data

- Use readings from end-user to create a artifical critical temperature for a distribution of houses in the network.
  - One possibility is to use pointwise quantile estimation.

Artifical Critical Temperature created from Smart-Meter Data



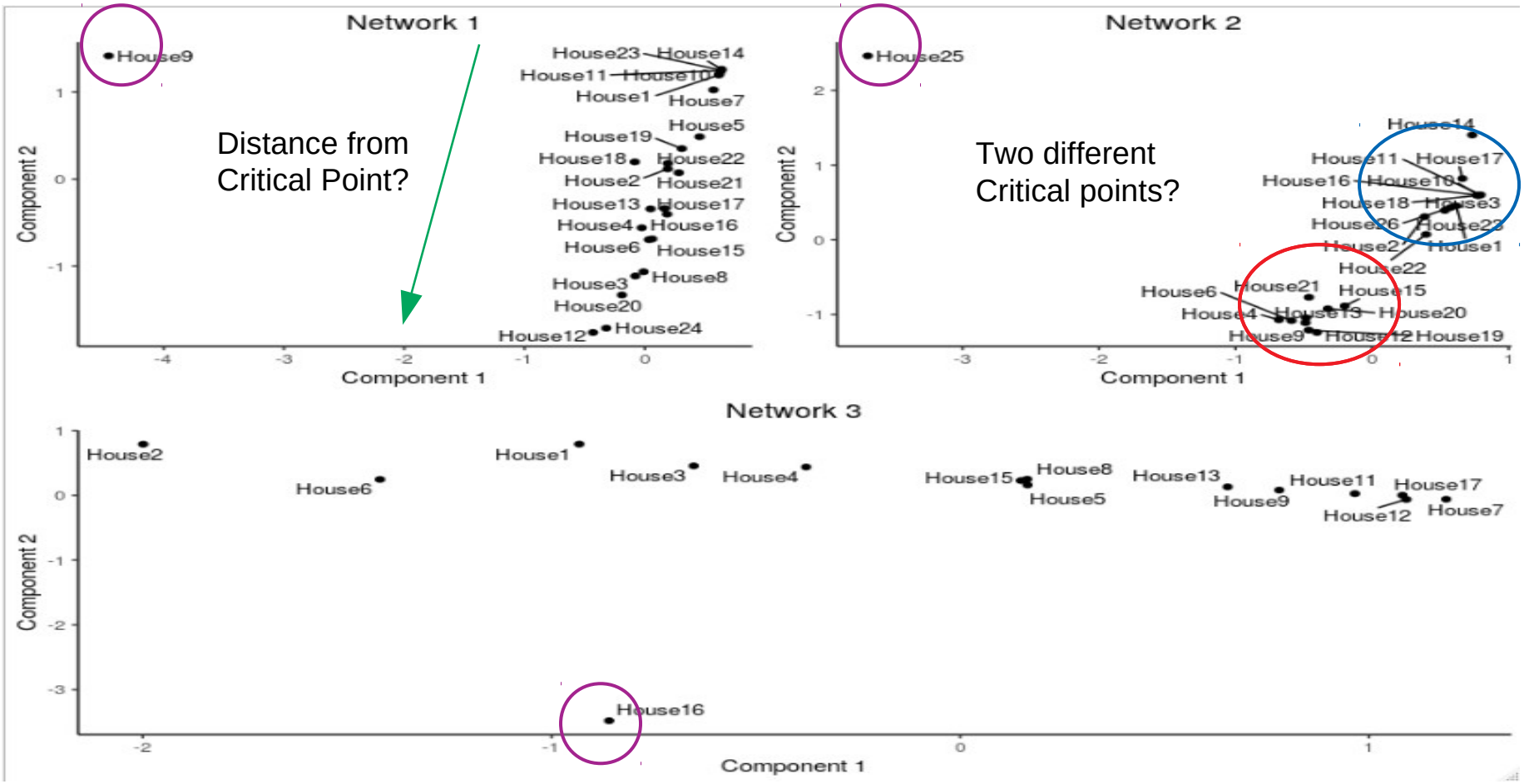
Time-of-the-Week distribution



Clustering Houses based on consumption

- Identify based on the clustering
  - Temperature/flow drop in the pipe system.
  - Areas inside the critical point having different consumption dynamics
- Located low and high temperature areas inside the DH network and control it using HEATTO and the artifical critical temperature.

Identify new critical points or problems in the network



For more information …

See for instance

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…or contact

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